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Kathleen P. Anderson
University of Nebraska - Lincoln, kanderson1@unl.edu

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NebGuide

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Managing to Prevent Equine Developmental Orthopedic Diseases

This NebGuide describes and discusses management techniques to prevent orthopedic disease in horses.

Kathy Anderson, Extension Horse Specialist

Equine Developmental Orthopedic Disease (DOD) is a significant problem facing today's horse breeders. A serious case of DOD can render a young horse essentially worthless due to crippling lameness. There is continuous debate as to the interplay of nutrition, management, genetics and exercise on the incidence of bone disease in young, growing horses. In the early stages, growing horses may appear unaffected by the disease, but may later develop lameness and eventually chronic arthritis. Recent research has identified many factors which will aid breeders to minimize the incidence of DOD.

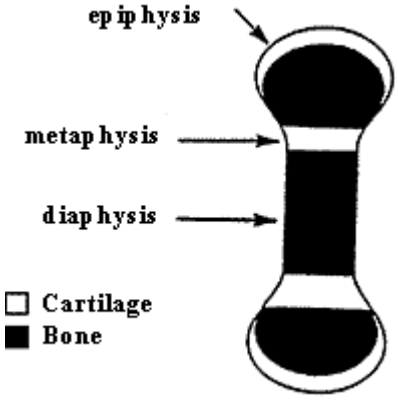

Figure 1. Normally developing bone.

Normal Bone Development

In young growing horses, skeletal bones initially develop from cartilage, which is gradually converted into hard bone through endochondral ossification. During maturation, two growth plates develop at each end of the long bones. The epiphysis faces the joint, and the metaphysis faces the shaft of the bone and together are called the physis (*Figure 1*). During endochondral ossification, special cartilage cells grow, swell and then die, to be replaced by living bone.

Errors in bone development occur as a result of difficulty in getting blood supply into the cartilage growth areas. Problems occur when bone growth is interrupted. If the supply of vital nutrients via blood to the developing area is impaired, the growth process is compromised.

Developmental Orthopedic Disease

Developmental orthopedic disease of young, growing horses includes any disturbance in changing the cartilaginous precursor of the skeleton to functional bone. Six distinct disease entities fall under the general term developmental orthopedic disease.

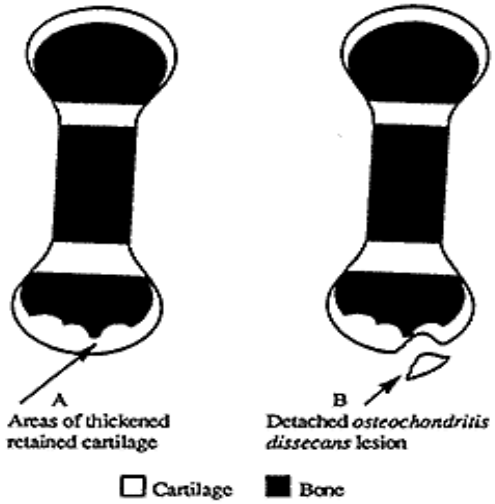

Figure 2. A) Osteochondrosis (thickened cartilage); B) *Osteochondritis dessicans*.

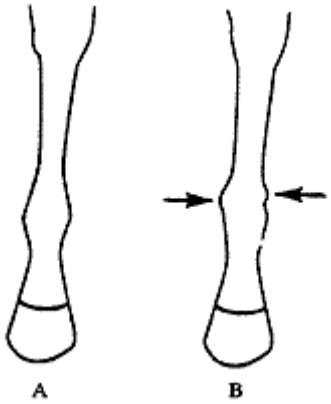

Figure 3. Enlargement of the epiphyseal and/or metaphyseal area. A) normal fore limb; B) affected fore limb.

The different DOD disease entities include:

1. Osteochondrosis dessicans—A flap develops from the articular cartilage due to failure of cartilage to be properly converted into bone (*Figure 2*).
2. Subchondral bone cysts—Occur as a result in failed endochondral ossification.
3. Epiphysitis and physitis—An inflammation at the growth plate occurring when the bone is weak (*Figure 3*).
4. Osteochondrosis of the vertebral column (Wobbler syndrome)—Cervical vertebrae does not form correctly, pinching the spinal column.
5. Acquired angular limb deformities—Result from poor bone formation and unbalanced strength of the limb.
6. Flexural deformities such as contracted tendons—Result of poor bone formation and increased pain.

The conversion of cartilage into bone starts in the developing fetus and continues following birth and through maturity. Most DOD can therefore develop only during the growing stages of each bone. Lesions have been found in foals as young as three days of age. It may persist in mature horses, but once a bone has reached it's mature size, DOD will no longer develop. While some bone disorders may have developed during growth, an animal may not become lame until it is subjected to undo training stresses. However, some animals may never become lame.

Owners should avoid "growth spikes" in their young foals. A spike or growth surge commonly occurs following a period of stress and forced confinement perhaps due to illness, weaning, or shipping. An episode of DOD is often observed 6-8 weeks following a growth spike.

Contributing Factors

There is much debate as to the factors contributing to the occurrence of DOD. Several causes have been implicated such as genetics, nutritional imbalances, rapid growth rates, trauma or the amount and type of exercise. It is generally agreed that a combination of factors frequently contribute to DOD.

Genetics

Developmental orthopedic disease appears to be heritable in some horses. In one study, the progeny of some stallions were observed to have a significantly greater incidence of DOD than progeny from other stallions. The breeding of two "wobbler" parents resulted in increased DOD disorders. Additionally, horses with an inherent tendency for rapid growth often develop skeletal problems regardless of how they are managed.

Nutrition

Producers often desire large foals for maximal benefit in the sale or show ring. Excessive growth has been suggested to have a direct link with DOD. The balance of protein, calcium, and phosphorous in relation to energy is essential for optimal growth and skeletal development. It is debatable if elevated energy itself is a direct cause of DOD, but more likely is an imbalance of these nutrients. An animal growing at a more rapid rate has an increased requirement for all nutrients. If any imbalances are present, skeletal development may be compromised.

Growing horses fed elevated amounts of energy but low levels of other nutrients increase in weight before the skeleton has sufficiently developed to maintain the added weight. Recent work has suggested that foals may grow at a somewhat more rapid rate if all nutrients are balanced.

Other nutrients critical to bone formation include copper, zinc, manganese and selenium. Deficiencies/imbalances in calcium and phosphorus are primarily involved with bone mineralization and lead to weak, cancellous bone which can result in fractures of the coffin or sesamoid bone.

Table I. Daily nutrient requirements of growing horses (1,100-pound mature weight).

Class	Digestible energy (Mcals)	Crude protein (pounds)	Calcium (grams)	Phosphorus (grams)	Vitamin A (IUs)
Weanling (4 months)	14.4	1.60	34	19	8,000
Weanling (6 months)					
• Moderate growth	15.0	1.65	29	16	10,000
• Rapid growth	17.2	1.90	36	20	10,000
Yearling (12 months)					
• Moderate growth	18.9	1.90	29	16	15,000
• Rapid growth	21.3	2.10	34	19	15,000
Long yearling (18 months)					
• Moderate growth	19.8	2.00	27	15	18,000
• Rapid growth	26.5	2.60	36	20	18,000

Much has been written about copper and its relationship with the occurrence of DOD. Copper supplementation has been suggested to reduce some physical problems which occur during ossification. DOD was less in weaned foals fed diets containing 30 ppm copper compared to those fed 7 ppm copper. However, excessive copper supplementation can induce a selenium deficiency. Also, toxic levels of zinc appear to interfere with copper absorption. Current NRC (National Research Council) recommended total diet levels of zinc and copper are 40 ppm and 10 ppm. The most common situation for a copper deficiency to occur is when a whole grain diet is fed. Copper levels in commercially prepare diets commonly meet and exceed the recommended levels and have acceptable zinc:copper ratios.

General feeding recommendations

Horse owners should realize there is no single "magical" ration to absolutely prevent DOD due to the interrelationships of the numerous contributing factors. Avoid supplementing a commercially-prepared feed with extra nutrients. The commercially prepared feed has been formulated to contain a balance of nutrients. Any supplementation with additional protein, minerals, or vitamins will lead to a nutrient imbalance. Producers mixing their own rations should have the total diet (grain mixture and hay) regularly analyzed to ensure proper diet formulation. The most useful analysis can be done at a lab which analyzes swine or beef feeds. Daily nutrient requirements for growing horses are given in *Table I*, and two sample rations are given in *Table II*.

Table 2. Creep feed and weanling rations.

	Ration A[1]		**Ration B[2]**			**Calculated Analysis Ration**	
Ingredients	**Percent**	**lb/ton**	**Percent**	**lb/ton**		**A**	**B**
Cracked corn	40	800	47.5	950	Crude Protein	16.5%	14.7%
Oats	32.5	650	30	600	Lysine	.80%	.66%
Soybean meal	20	400	15	300	Digest energy	1.39 mcal/lb	1.42 mcal/lb
Molasses	5	100	5	100			
Calcium carbonate	1	20	.5	10	Calcium	.80%	.66%
Dicalcium phosphate	1	20	1.5	30	Phosphorus	.50%	.63%
TM salt	.5	10	.5	10	Vitamin A	added at	added at
Vitamin A	+	+	+	+		1200 IUs/lb	1.500 IUs/lb

[1]To be fed with good quality grass hay or pasture.
[2]To be fed with alfalfa hay.

Exercise

A feeding program designed for optimal growth rates should consider the foal's exercise program. An energy intake which is considered correct for a foal receiving adequate exercise, will probably be excessive for a foal restricted to a stall or small lot. Intense hard work, if gradually introduced,

encourages proper bone remolding. Additionally, any exercise or conditioning program should include ample free exercise. One program to provide time for proper bone remolding and improved strength is to weekly alternate intense work, free exercise and moderate exercise. In a recent study, less DOD was developed in rapidly growing foals which were galloped and trotted for 15-45 minutes, 5 days a week from 3 to 24 months of age on firm ground compared to foals which were walked. High intensity, short duration exercise appears to provide a somewhat protective effect from DOD. The best stimulus is to provide short periods of hard work on firm footing, combined with free exercise on soft footing. Excessive force or free exercise on firm footing may cause trauma to the developing skeleton.

Any sudden change or increase in the exercise program can contribute to DOD occurrence. If exercise is curtailed for a prolonged period of time, it must be gradually resumed. If the return to exercise is accompanied with indications of bone overload (lameness, inflammation), the quantity of exercise must be reduced then gradually increased. Heavy work, without adequate preparation or even a traumatic blow can lead to bone growth errors.

Tips to Aid in Prevention of Developmental Orthopedic Disease

- Analyze hay and grain annually to detect any major alterations. Commercially prepared diet analysis should be available.
- Allow nursing foals small, frequent meals (creep feeding) and all the hay or pasture they will consume.
- Avoid indiscriminate supplementation; know the total diet composition you are feeding.
- Respect the difference in "optimal" and "maximal" growth. Maximal growth requires exquisite attention in balances of all nutrients.
- Provide mares with proper prenatal nutrition.
- Use common sense in exercising foals and avoid abrupt changes in an exercise schedule. Allowing foals free exercise over large areas requires less management to ensure healthy growth.
- Observe foals daily for injury, lameness, gait alterations, etc.

There are many unanswered questions to the exact cause and cure of developmental orthopedic disease. Most will agree it is a multifaceted problem. Horse breeders must use good sound management and selection procedures, as well as feed well-formulated diets in a conservative manner. Additionally, the amount and type of exercises is critical. Choosing to supplement the diet should depend on the producer's history and degree of DOD. If there have never been problems with juvenile bone disease, the nutritional and management plans are probably adequate. However, if various problems continually occur such as angular limb deformities, contracted tendons, unexplained lameness, thicken growth plates, then there may be a need to evaluate the management plan including ration analysis and exercise program. Through good management, sound nutrition, and proper exercise, the incidence of developmental orthopedic disease can be reduced.

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